

ENVIRONMENTAL PROTECTION NOTE NO. 3

Estimation of the Annual Tritium Release due to Operation of the Magnet Debonding Oven

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Objective

It is the purpose of this note to document a method for estimating the total annual release of tritium to the atmosphere resulting from the operation of the Magnet Debonding Oven located behind Industrial Building #2.

History

Magnets used in the Main Ring accelerator at Fermi National Accelerator Laboratory (FNAL) are typically impregnated with epoxy resin to prevent coil movement during normal operation. When the magnets need repair or the coils must be replaced, the epoxy resin must be removed. In 1978 FNAL personnel determined that the most efficient way to remove this epoxy from the magnets was by heating the whole magnet in an oven at 800°F for 8 hours. Thus in October 1978 a Construction Permit Application was submitted by FNAL to the State of Illinois for construction of a magnet debonding oven. The resulting permit required the characterization of emissions to the atmosphere resulting from the operation of the magnet debonding oven. This was accomplished by a series of tests conducted by Fermilab personnel and an outside vendor, the Almaga Corporation, during the summer of 1979 (references AL1, SB1 and SB2).

Since the initial battery of tests conducted in the summer of 1979 (on a Class I magnet) two other attempts to further characterize the radioactive gas emissions from the magnet debonding oven have been made. The only extant documentation on the first attempt (ref. SB3) states that a 60 mR/hr magnet (Class III) produced ^3H emissions that reached 60% of the Concentration Guide. The second attempt (ref. SB4) to measure emissions from a Class II magnet was unsuccessful.

PROCEDURE

The actual data from the initial tests conducted in the summer of 1979 can be found in references LC1 and SB5. According to the FNAL Site Environmental Report for calendar year 1987 (ref. SB5), the emissions from debonding a class I magnet can be conservatively estimated as 160 uCi of ^3H . This estimate is based on an average stack ^3H concentration of 1.3×10^{-8} uCi/ml. Using the measured volume flow rate (ref. AL1) this corresponds to an average oven operation time of 6.3 hours/magnet.

In order to estimate the expected emissions from magnets other than Class I magnets, the data for the 60 mR/hr magnet (ref. SB3) can be combined with the data for Class I magnets to yield the linear relationship:

$$y = 1.16 \times 10^{-8} + 0.181 \times 10^{-8} x \quad (1)$$

where: y = the average ^3H concentration released in uCi/ml.
 x = the dose rate at 1 foot from the magnet in mR/hr.

Multiplying y by the volume flow rate (1.95×10^9 ml/hr) and the average burn time for a magnet (6.3 hr.) will then give an estimate of the total activity of any magnet with a dose rate of x .

APPLICATION

The total number of magnets debonded in any given calendar year and the dose rate of each at the time it was debonded can be obtained from the Senior Safety Officer of the Technical Support Section. At the current time that person is Dave Austin (X3446). The numbers for calendar years 1988 and 1989 were:

<u>Year</u>	<u>No. of Class I</u>	<u>No. of Class II</u>
1988	8	5
1989	3	1 (1mR/hr)

An estimate for calendar year 1988 has already been made by Sam Baker and included in reference SB6. If we assume that an average of 160 uCi of ^3H is released for each Class I magnet then a total of 480 uCi would be released for the 3 debonded in 1989. The Class II magnet was just barely above the Class I limit and probably could have been modeled as a Class I magnet with no loss of accuracy. Modeling it according to the relation in equation (1) gives an average release of 164 uCi. The total ^3H release from the magnet debonding oven for 1989 is then the sum, 644 uCi.

REFERENCES

- AL1 The Almega Corporation, "Stack Particulate Emission Testing Magnet Debonding Oven", June 8, 1979, Project I-5206.
- LC1 FNAL Safety Section letter to James O. Jackson at Los Alamos National Laboratory, Los Alamos, NM from Larry Coulson.
- SB1 FNAL Safety Section memo from Sam Baker to the Almega Corporation dated June 11, 1979.
- SB2 Notes from the June 8, 1979 tests of the Magnet Debonding Oven made by Sam Baker.
- SB3 FNAL Safety Section memo from Sam Baker to Frank Kleber on Debonding Oven Procedures dated April 7, 1980.
- SB4 FNAL Safety Section memo from Sam Baker to Phil Gavin on the measurement of radioactive effluents dated October 5, 1984.
- SB5 S.I. Baker, Site Environmental Report for Calendar Year 1987, Fermilab 88/40 1104.100 UC-41, May 1, 1988.
- SB6 S.I. Baker, Site Environmental Report for Calendar Year 1988, Fermilab 89/63 1104.100 UC-41, May 1, 1989.